Amphioxus, which so closely resembles an Ascidian in its development, has a perivisceral cavity which essentially corresponds with the atrium of the Ascidian, though it is formed in a somewhat different manner. One of the most striking peculiarities in the structure of *Amphioxus* is the fact that the body wall (which obviously answers to the somatopleure of one of the higher *Vertebrata*, and incloses a "pleuro-peritoneal" cavity, in the walls of which the generative organs are developed) covers the branchial apertures, so that the latter open into the "pleuro-peritoneal" cavity. This occurs in no other vertebrated animal. Kowalewsky has proved that this very exceptional structure results from the development of the somatopleure as a lamina which grows out from the sides of the body and eventually becomes united with its fellow in the middle ventral line, leaving only the so-called "respiratory pore" open. Stieda has mentioned the existence of the raphé in the position of the line of union in the adult animal. Rathke described two "abdominal canals" in *Amphioxus;* and Johannes Müller, and more recently Stieda, have described and figured these canals. However, Rathke's canals have no existence, and what have been taken for them are simply passages or semi-canals between the proper ventral wall of the abdomen and the incurved edges of two ridges developed at the junction of the ventral with the lateral faces of the body, which extend from behind the abdominal pore where they nearly meet, to the sides of the mouth. Doubtless, the ova which Kowalewsky saw pass out of the mouth, had entered into these semi-canals when they left the body by the abdominal pore, and were conveyed by them to the oral region. The ventral integument, between the ventrolateral laminæ, is folded, as Stieda has indicated, into numerous close-set, longitudinal plaits which have been mistaken for muscular fibres, and the grooves between these plaits are occupied by epidermic cells, so that, in transverse section, the interspaces between the plaits have the appearance of glandular cœca. This plaited organ appears to represent the Wolffian duct of the higher *Vertebrata*, which, in accordance with the generally embryonic character of *Amphioxus*, retains its primitive form of an open groove. The somatopleure of *Amphioxus* therefore resembles that of ordinary *Vertebrata* in giving rise to a Wolffian duct by invagination of its inner surface. But the Wolffian duct does not become converted into a tube, and its dorsal or axial wall unites with its fellow in the raphé of the ventral boundary of the perivisceral cavity.

In all the higher *Vertebrata* of which the development has yet been traced, the "pleuro-peritoneal" or perivisceral cavity arises by an apparent splitting of the mesoblast, which splitting, however, does not extend beyond the hinder portion of the branchial region. But, in many *Vertebrata*, (*e.g.*, *Holocephali*, *Ganoidei*, *Teleostei*, *Amphibia*) a process of the integument grows out from the region of the hyoidean arch, and forms an operculum covering the gill-cleft. In the frog, as is well known, this opercular membrane is very large, and unites with the body wall posteriorly, leaving only a "respiratory pore" on the left side, during the later periods of the tadpole's life. Here is a structure homologous with the splanchnopleure of *Amphioxus;* while, in the thoraco-abdominal region, the splanchnopleure appears to arise by splitting of the mesoblast. Considering what takes place in *Amphioxus*, the question arises whether the "splitting" of the mesoblast in the *Vertebrata* may not have a different meaning from the apparently similar process in the *Arthropoda*, *Annelida*, and *Mollusca;* and whether the pericardium, pleura, and peritoneum are not parts of the epiblast, as the atrial tunic is of the epiblast of the ascidians. Further investigation must determine this point. In the meanwhile, on the assumption that the "pleuro-peritoneal" cavity of the *Vertebrata* is a virtual involution of the epiblast, the peritoneal aperture of fishes becomes truly homologous with the "respiratory pore" of *Amphioxus;* and the Wolffian ducts and their prolongations, with the Müllerian ducts, are, as Gegenbaur has already suggested, of the same nature as the segmental organs of worms.

The division of METAZOA without an alimentary cavity is established provisionally, for the *Cestoidea* and *Acanthocephala*, in which no trace of a digestive cavity has ever been detected. It is quite possible that the ordinary view that these are Gastreæ modified by parasitism is correct. On the other hand, the cases of the Nematoid worms and of the *Trematoda* show that the most complete parasitism does not necessarily involve the abortion of the alimentary cavity, and it must be admitted to be possible that a primitive Gregariniform parasite might become multicellular and might develop reproductive and other organs, without finding any advantage in an alimentary canal. A purely objective classification will recognise both these possibilities and leave the question open.

THE "TIMES" ON THE IMPORTANCE OF SCIENTIFIC RESEARCH

[In an article which appeared in yesterday's *Times*, occasion is taken of the occurrence of the Transit of Venus to point out the great activity now being displayed by foreign nations in the prosecution of abstract scientific inquiries, and the necessity of retaining England's old pre-eminence in this respect. The article is so important as indicating the growing importance which is being attached to research, that we reproduce a great part of it in our own columns, because the considerations urged by the *Times* lead to a conclusion of no uncertain sound. As England has nobly in the past, when she was almost alone, led in the search after abstract scientific truths, it behoves her now that she is by no means alone and has to compete with rivals who have shown by their Transit expeditions and by many other signs what their opinion is on this matter, to more than redouble her old efforts, if she wishes to retain the position she has won by the accumulated work of centuries.—Ed. Nature.]

THE astronomer's point of view is by no means the only one of general interest connected with the recent Transit. We have, first of all, the remarkable spectacle of trained observers of almost all nationalities—observers sent out by England, the United States, France, Germany, Italy, and Holland — distributed among some seventy stations, some of them the most inhospitable islands of the Southern seas, engaged upon one of the most abstract inquiries which can be imagined. The anxiety of the various European and the American Governments to contribute towards the solution of the problem can perhaps best be shown by indicating the stations occupied this morning by the various parties. The English flag floats over the observatories of three parties in the Sandwich Islands, two parties in Kerguelen's Land, one in Rodriguez, one in New Zealand, two in Egypt, and one in India; nor must we omit to mention Lord Lindsay's station in the Mauritius, though his is a private expedition. This is a goodly list, but it is surpassed in its area of distribution by the American expeditions, which occupy Vladivostok in Siberia, Tien-tsin, a station in Japan, and in the Southern seas Kerguelen's Land, the Crozets, Hobart Town, Bluff Harbour (New Zealand), and Chatham Island. France has seven stations—Campbell and St. Paul's Islands, Noumea, Pekin, Yokohama, and Saigon. Russia does not occupy any southern stations, but she makes up for this by observing at no less than thirty stations within her own territory. The German Government has equipped five southern parties, while Holland is represented at Réunion. Italy has a party in Egypt. She was to have been represented by four parties in all; but little is known of her arrangements.

The number of observed Transits has been so few that it is an easy task to contrast the present arrangements with what was done in former times. Horrox, one of the most gifted of English men of science—whose memory, we rejoice to know, will this year be appropriately, if tardily, perpetuated by a tablet in Westminster Abbey—predicted the Transit of 1639 so shortly before he observed it that there was no time, if, indeed, there had been any desire, to send observers from England. When the next Transits occurred in the following century, in the years 1761 and 1769, the expeditions were few. In the former year we had an English expedition to Sumatra and a French one to Pondicherry, neither of which reached its destination; and there was another French expedition to Tobolsk. Observations were made at many places, the unfortunate Le Gentil, the French Envoy to Pondicherry, making his on board ship. In 1769 came the celebrated voyage of Captain (then Lieutenant) Cook, in the *Endeavour*, to Otaheite, on behalf of England. The King of Denmark sent an observer to Lapland; and the French Academy despatched one to California, in addition to Le Gentil. The latter had waited at Pondicherry since 1761, hoping to make up by good fortune in 1769 for his partial want of success in 1761, but the Fates were against him.

It will be seen from this rapid statement that, so far as the number of the *personnel* is concerned, the present expeditions are beyond all precedent. This remark naturally applies much more strongly to the means of observation. Not only do modern telescopes bear the same relation to those used on former occasions as a Woolwich gun does to a smooth-bore musket, but two new instruments of inquiry have been added to the scientific stock-in-trade. This morning, if the weather has been favourable, more than a score of cameras have obtained permanent records of the black spot travelling over the sun's disc at one part or another, or during the whole time of its passage, and if the spectroscope has not been used to record the planet's contact with the sun long before the eye or photographic plate could detect her presence, and again to mark the exact instant at which she parted company with it, it is not the fault of the instrument. But it is not merely to the *personnel* nor to the instruments employed that we wish to draw chief attention, but rather to the indications afforded that the example which England and France have of old set in promoting such inquiries is being followed by other nations, and with a most remarkable vigour and intensity of purpose. Denmark, which took no part in this morning's observations, has been replaced by the United States, Germany, Holland, and Italy, and the part played by these nations, new to this peaceful strife, is most important. The United States lead all the other nations, in respect both of the amount of money which her Government has contributed, and of the discomfort, not to say dangers, of the stations she has chosen in the Southern seas. Posts of importance which were given up as too hopelessly miserable even for enthusiastic English astronomers will be occupied by Americans. The Germans have closely followed England and the United States in this noble competition, and although the sum contributed by the German Government is small compared with the American subsidy, the German observations made this morning in the South seas will be among the most important obtained by all the expeditions. With regard to Italy, also, there are the same signs of scientific enterprise. The spectroscope, which forms no part of the equipment of the English expeditions, was intended by her men of science to be their chief weapon of attack, and as in no country is there such a skilled body of spectroscopists as in Italy, this determination was probably not arrived at on insufficient grounds.

What, then, is the meaning of all this? It is that as the world grows older each nation as it develops, as the United States, Germany, and Italy have of late largely developed, under modern conditions, feels the necessity for taking a continual and a largely increasing share in the promotion of science even in its most abstract forms. It should be a subject of pride for us to know that in this they are but following the example set by England in former centuries, including the days "when George III. was King." If we consider the revolutions effected by science since Capt. Cook's famous expedition to observe the last Transit, we shall not be astonished that the nations are beginning to vie with each other so eagerly in its development. When Cook sailed in 1768, Watt was thirty-two years of age; in the very year of the Transit he introduced the closed cylinder, and so gave us the steam-engine of to-day in its essential point. In the same year the founders of chemistry were in their early prime. Priestley was thirty-six years of age, Cavendish thirty-eight, Black forty-one, and Lavoisier twenty-six; Dalton was three years old. What has not chemistry done for England since their time? Be it always remembered that all the work of these men was of the most abstract kind, and yet that out of it has grown insensibly a large part of England's commercial greatness. Nor is this all. There is another development of science still which must be mentioned, but which is of so recent a date that in 1769 no one whose name is now associated with one of the greatest triumphs of science was born. We refer to those discoveries that have belted our world with the electric wires which to-day, from the most distant parts of our planet's surface, will bring to Europe the results of this morning's work.

It is a proper subject of national pride that the benefits derived by the world from the invention of the steam-engine and the electric telegraph, and from the various applications of chemistry to the industrial arts, have all, until the last few years, radiated from England. We have here the secret of a large part of England's riches and England's strength. But it is useless to hope that the mere knowledge of the acquired facts of science will furnish that new weapon which nations are now adding to the sword to enforce their superiority. The mental soil which produces new ideas for a nation's use can only be cultivated by the discipline of scientific investigation. Further, it cannot be doubted that, as modern civilisation is still further developed, the new ideas which a nation produces and throws into a concrete form will be among the most valuable of its exports, because each nation will work up the old ideas for itself.

AGRICULTURAL EDUCATION

THE application of the law of selection to the production of farm crops and animals offers a certain and wide field for increasing our agricultural wealth. In every department of the farmer's occupation there is great room for improvement if this scientific principle be borne in mind.

It is well known that science has, in our time, thrown extraordinary light on the action of manures. Yet too few of our farmers are guided in their practice by this light. In every district of the United Kingdom farmers apply manures which are either incapable of drawing out the full productive powers of the soil, or comparatively worthless.

Again, it is notorious that the yield of millions of acres of our wet, cold lands could be largely increased by drainage.

There is no branch of agriculture which has progressed so much in modern times as the manufacture of farm implements and machines. Yet, an enlightened and experienced agriculturist who travels through England cannot fail to see an enormous waste of power, arising from the use of unsuitable implements, as well as from ignorance of the elementary principles of mechanical science.

Numerous additional examples could be cited, but it is not necessary. It is enough to state the broad fact that while the foremost of our farmers are the most enlightened in the world, there is a vast number of occupiers of land in Great Britain and Ireland who do not avail themselves of the aids which science is capable of affording them.

To the farmer, as to everybody else, knowledge is power. The increased annual wealth capable of being produced by the application of this power is very considerable. It has been stated by several persons whose opinions on agricultural questions appear to command respect, that the produce of the soil of England could be doubled by improved modes of farming. After having seen from time to time a good deal of English farming, I consider this estimate quite too high; but all thoughtful and experienced persons will concur in the opinion that by the adoption of means which could be called forth, the produce of the soil of Great Britain would soon be increased to an amount equal to the rental of the entire land of the country; that is to say, *farmers could increase the productive power of the soil to the extent of, say, forty millions sterling a year!* They would reap the first fruits of this harvest. In due time the landlords would come in for their share of it in the shape of increased rents; for, as I have often pointed out, it is a law of agricultural progress that every increase in the productiveness of the land, and every rise in the prices of its products, by increasing the competition for land, tend to raise rents.

How can we increase the productiveness of the land? There are many ways in which progress may be effected; but we must seek the solution of the question mainly in education, using the word in its widest sense.

The wealth of farmers depends on their knowledge, skill, and thrift. Of thrift we shall say nothing in this note. Skill is required by both farmers and labourers. It is a plant of slow growth. The navvy acquires it by plodding application. The skill of the high-class agricultural labourer is acquired in the same way. The skill of the high class-farmer, too, is the result of continuous application to business. The skill acquired by one generation is capable of being imparted to, and of being improved upon, by the next. The skill possessed by both agricultural labourers and farmers in England has been thus transmitted from generation to generation, and improved in its transmission, in accordance with a law of development. It would be unfortunate if any circumstances or set of circumstances should interfere with this development. We cannot now discuss this subject; but it may be remarked that one of the features of the present movement in the agricultural labour market which deserves serious attention is, that skilled hands have left many districts. Several very thoughtful English farmers of my acquaintance already complain of want of skill in the young hands who remain at home. In a recent agricultural tour in England I saw evidence of the same state of things. Unless the movement be arrested, English farming will, in all human probability, undergo a change which may be prejudicial to the agricultural interest. What the tendency of that change would be is foreign to the object of this paper, and accordingly I proceed to make a few remarks on the importance of imparting agricultural knowledge.

It has been already affirmed that general knowledge imparts power to every man. This is true in every state of life. It is true in science; it is equally true in the industrial arts. The proposition is supported by an overwhelming mass of evidence. Royal Commissioners, Special Commissioners, and distinguished independent inquirers are all in unison on the question. All our systems of technical education are based on this one leading idea. The whole programme of the Department of Science and Art is based upon it. In the leading cities and towns the rising generation of the manufacturing classes can acquire scientific knowledge which will be of direct use to them in their several pursuits. In the village school scientific truths are imparted which cannot fail to be of use to the trader and artisan.

How different is the case with the farmer! In his education no systematic effort has been made to instil into his mind those elementary scientific truths on which